8.

HEADS
OF A
COURSE of LECTURES
OF
NATURAL AND EXPERIMENTAL
PHILOSOPHY,
On the following intereſting Subjects, viz.

Properties of Matter,
Mechanics,
Pneumatics,
Pneumatic Chymistry,
Hydrostatics,
Optics,
Electricity,
Magnetism,
Central Forces, and
Astronomy.

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BY

Mr. JOHN BURTON,

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Φίλος τῆς φύσεως.

Philoſophia mater omnium bonarum artium, nihil eſt aliud, niſi, ut Plato ait, donum et Inventum Deorum.
Cicero, I Tuſc.

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TO enumerate the ſeveral and great Advantages accruing to Mankind from Experimental Philoſophy, and the daily Improvements the Arts and Sciences receive from it, requires more Room than the narrow Limits of a Syllabus admits of.

The great End of Philoſophy is to render us more wiſe and happy, by inculcating the Principles of true Virtue and Morality, and teaching us to ſubdue our Paſſions to our Reaſon.

The peculiar Advantage reſulting from Experimental Philoſophy is, the pleaſing Inſtruction and ſatisfactory Conviction with which it impreſſes the Mind, conveying more real Knowledge in a few Hours, than can be obtained from Books in as many Years; and as a Taſte for polite Literature, and the Works of Nature and Art united to a proper Knowledge of Philoſophy, is eſſentially neceſſary to complete the Gentleman, and more eminently diſtinguiſhes him from the Vulgar, than any Advantage he may derive over them from Birth or Fortune, and ſecures him a favourable reception in the World, and is thereby let into a great many Pleaſures the Vulgar are incapable of enjoying.

Theſe Conſiderations render it a Subject truly intereſting to Mankind in general, but more particularly ſo to thoſe Ladies and Gentlemen whoſe liberal Education makes them ſenſible of the Neceſſity and Advantages of being inſtructed in the more ſublime Parts of Knowledge, by inquiring into thoſe Laws the Almighty has eſtabliſhed for the regulating and conducting of his Works.

The Apparatus for illuſtrating the ſeveral Subjects being intirely new, and conſtructed on the lateſt and moſt approved Principles, is univerſally allowed to be the moſt elegant and extenſive in the Poſſeſſion of any private Perſon in theſe Kingdoms, the Proprietor flatters himſelf they merit the Attention of the Public, and doubts not they will meet their Approbation.

This Courſe conſiſts of Twelve Lectures, at One Guinea each Subſcriber; to commence as ſoon as thirty have ſubſcribed. The Subſcription to be paid after the firſt Lecture, which, if diſapproved, every Subſcriber ſhall be at Liberty to withdraw his Subſcription. Tickets to Non-Subſcribers, Two Shillings and Six-pence each. Tickets transferable.

LECTURE

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LECTURE I.

On the general Properties of MATTER.

MATTER, what; its Solidity, Vis Inertiæ, Mobility, impenetrable Hardneſs, and infinite Diviſibility, proved. Attraction, what; its Kinds; Coheſion, Gravitation, Magnetiſm, and Electricity. Coheſion, what; its various Degrees in different Bodies. Its Laws deduced from the Aſcent of Water in Capillary Tubes. The Hyperbolic Curve illuſtrated, by the Aſcent of Water between two Glaſs Planes. Fluidity and Solidity, Cauſe of. Attraction of Gravitation, what; demonſtrated to be as the Quantity of Matter in Bodies. Decreaſes as the Squares of the Diſtances increaſe. The Newtonian Laws of Motion proved experimentally by an entire new and elegant Machine, invented by one of the firſt Mathematicians of the Age, by which that much-controverted Subject, the Momentum, or Quantity of Force in a moving Body, will be ſhewn to be as the Quantity of Matter multiplied into its Velocity; being the only Machine of the Kind ever exhibited in Public in theſe Kingdoms. The Velocity of Bodies falling in Vacuo by no Means proportioned to their comparative Weights, experimentally proved. Bodies projected in horizontal Directions, will, in their Deſcent, deſcribe the parobolic Curve, ſhewn. Centre of Gravity and Line of Direction, what. Shewn by a Body's rolling up hill. How much a Building may decline from the Perpendicular without falling, ſhewn. The Danger of riſing ſuddenly in a Coach or Boat, that is likely to overſet, ſhewn. The Effect of Heat on Metals, experimentally ſhewn by a new and elegantly conſtructed Pyrometer.

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LECT. II. MECHANICS.

THE general Principles of Mechanics. The Momentum, or Force of any Machine, how calculated. The Mechanic Powers explained by Experiments on ſimple and compound Levers; the Axis in Peretrochio; ſimple and compound Pullies; the inclined Plane; the Wedge and the Screw. Their conjoined Forces ſhewn by a Machine compounded of all the Mechanic Powers united. What allowance to be made for Friction. Experiments on Friction, in the Conſtruction of Waggons with narrow and broad Wheels, Friction Wheels, high and low Wheels. The Abſurdity of the common Method of loading Waggons, and placing the Wheels, ſhewn. How beſt to apply Strength in the yoking of Horſes. A curious Model of Vaulou's Engine, uſed for driving the Piles at Weſtminſter and Black Fryars' Bridges. Model of an uſeful, ſafe, and cheap Crane.

LECT. III. PNEUMATICS.

PERENNIAL, ſtated, and variable Winds, as the Trade Winds, Monſoons, Land and Sea Breezes, &c. Cauſe of. Of the Air in general. The vivifying Spirit of Air, how vitiated and rendered noxious. Vapours, how produced. Meteors, Cauſe of. Choak Damp and Fire Damp in Mines, how produced. Thunder and Lightning accounted for. Earthquakes, Cauſe of. How an artificial Earthquake may be made. Subterranean Fires how produced, ſhewn. Air defined. Its Gravity of Weight proved by a Variety of curious and entertaining Experiments; as, by the Adheſion of a Recipient to the Plate of the Pump, and by fixing two Braſs Hemiſpheres together. By a Mercurial Shower. By the Burſting a Bladder tied over the Mouth of an open Receiver. By the breaking a Bottle. By weighing it, and various other Experiments. Its repulſive Force, or Elaſticity, ſhewn by forcing Water out of a Bottle, and the Contents of an Egg out of its Shell. By ſwelling an empty Bladder, and making it appear as full blown. By the burſting of a Bladder, or Bottle. By Faux's Images. By raiſing and ſupporting ſeveral heavy Weights, and a Variety of other entertaining and inſtructive Experiments. All Subſtances whatever replete with Air, proved. Neceſſary for Vegetation and the Support of animal Life. Nature of the Hoar Froſt, ſhewn by Experiment. That it preſſes in all Manner of Directions, ſhewn. It is the Pabulum for the Conveyance of Sounds, and the Exiſtence of Fire and Flame, proved. Opacity and Tranſparency of Bodies, Cauſe of. How Animals are affected in Vacuo, and the Manner of Reſpiration, ſhewn. That the true Weight of Bodies cannot be obtained by weighing in Air, proved. The Rationale of Pump-Work, explained. The Principles of the Barometer, ſhewn. That the Medium of Air neither prevents or aſſiſts the attracting Power of Bodies npon one another. The dangerous Effects of Charcoal Fires in Bed Chambers and cloſe Rooms. The Nature of Halo's explained.

LECT. IV. PNEUMATIC CHYMISTRY.

EXPERIMENTS on condenſed Air. On the new Patent Air Pump, Fountains, &c. Experiments to ſhew the natural Production of Air. Dr. Prieſtley's celebrated Experiments on Factitious Airs. Of fixed or mephitic Air; how produced; its great Antiſeptic Qualities; Water impregnated with it acquires not only the Taſte and ſparkling Appearance, but alſo the Virtues of the Seltzer and Pyrmont Waters, with the Method of impregnating it therewith. Its Property of diſſolving calcareous earths, ſhewn. Nitrous Air, how produced; its wonderful Property of diminiſhing common Air, being a Teſt of its Salubrity; its Antiſeptic Qualities. Dephlogiſticated Air, how produced; is ſo much purer than common Air, that an Animal will live in it a conſiderable longer Time than in an equal Quantity of common Air, experimentally illuſtrated. Uſeful in the Reduction and Calcination of Metals, experimentally illuſtrated. Inflammable Air, how produced. Cauſe of the Inflammability of Bodies. Mixed with dephlogiſticated Air, explodes with an extraordinary loud Report. Fluor Acid Air, how produced; its corroding Nature. Vitriolic Acid, Marine Acid, and Alkaline Air, how produced.

LECT. V. HYDROSTATICS, &c.

HYDROSTATICS, &c. defined. Their Uſe. A Fluid defined. That Fluids preſs in all Manner of Directions, proved. Bodies ſpecifically heavier than Water may be made to ſwim therein; and Bodies ſpecifically lighter than Water may be ſunk therein. Water always riſes to its own Level; unknown to the Romans. Fluids preſs directly as their Baſes and perpendicular Heights, without any Regard to their Quantity, proved. Lighter Fluids will gravitate upon a heavier, ſhewn. The Method of weighing Bodies in Water, and thereby determining their ſpecific Gravities. The Method of aſcertaining

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the true Value of Coin, and whether Metals are adulterated, ſhewn. Invented by Archimedes. Fluids weigh equally heavy in their own Elements as in Air, proved. The Doctrine of Spouting Fluids, illuſtrated. The Force with which Water preſſes againſt Banks of Rivers, Flood-gates, &c. ſhewn. The Proportion of Water diſcharged by Pipes of different Bores, at equal Depths. The Principles of Reciprocating and Intermitting Springs, demonſtrated. The Rationale of the Common and Forcing Pumps. Hydrometer, Conſtruction and Uſe of. Thermometer, Uſe of and Conſtruction. Cold produced by Evaporation, ſhewn. A new Machine invented by Mr. Burton for aſcertaining the Longitude at Sea, and which has met the Approbation of ſeveral celebrated Philoſophers.

LECT. VI. *and* VII. ELECTRICITY.

ELECTRICITY defined. Electric and Non-Electrics, what. Its attractive and repulſive Properties. Franklinean Theory of Negative and Poſitive Electricity, explained. Theory of Points, and the Leyden Phial, explained. The Method of charging Glaſs, and other Electric Subſtances. Proved to be Elementary Fire, by firing Spirits, Gun-powder, and other inflammable Subſtances, and fuſing of Metals. Its Effects upon Animal Fluids and the Human Body, in curing Diſorders cauſed from Obſtructions. The Theory of Rain, proved experimentally. Lightning and the Electric Fluid the ſame, proved. The Method of preſerving Buildings from the Effects of Lightning, ſhewn. Theory of the Electrophorous. Ocular Demonſtration of the Franklinean Hypotheſis of Negative and Poſitive Electricity, proved by ſeveral curious Experiments in Vacuo, compriſing a Set of the grandeſt and moſt ſtriking Experiments in Nature, many of which were never exhibited before in public.

LECT. VIII. OPTICS.

THEORY of Light. Its Materiality, Fluidity, and Velocity, proved. The Laws of Refraction and Reflection, explained. The Effects produced by Plane, Convex, Concave, and Cylindrical Mirrors. Effects produced in paſſing through Convex and Concave Lenſes, and the Sides of a Priſm. The Coats and Humours of the Eye, deſcribed and diſſected. Its wonderful Property of adapting itſelf to the viewing of Objects at different Diſtances, explained. Particular Eyes aſſiſted by the Uſe of Convex and Concave Glaſſes, explained by a new-conſtructed artificial Eye. The Theory of Colours. The Phenomenon of the Rainbow. Why it always appears circular. Why the Colours in the outer Bow are in an inverted Order. Of Single, Compound, and Solar Microſcopes, Dioptric and Catoptric Teleſcopes, their Uſes and Structures explained. The Cauſes of the Imperfection of Teleſcopes, and the great Improvement made therein, ſhewn. Opera Glaſs, Camero Obſcura, &c. &c.

LECT. IX. CENTRAL FORCES.

CENTRAL Forces defined. All Motion naturally Rectilineal. Newtonian Laws of Motion explained. The Effects of Combined Forces. The Laws of the Planetary Motions. The Curves deſcribed by Bodies revolving round their Common Centre of Gravity, ſhewn. A Double projectile Force will balance a Quadruple Power of Gra-

vity

vity in the ſame Orbit, experimentally proved. The Vis Inertiæ of Matter, proved. Bodies moving in Orbits have a Tendency to fly out of thoſe Orbits, proved by Experiment. Bodies moving one round the other, both muſt move round their Common Centre of Gravity, proved experimentally. The Differences of Central Forces ariſing from various Cauſes compared experimentally by a new and elegant Central Force Machine. The Application of theſe Laws, in determining the Diſtance of the Planets from the Sun. The Carteſian Doctrine, that the Planets are carried round the Sun in Vortices, refuted. Theory of the Tides explained by an elegant Experiment. The Earth's Motion round the Sun demonſtrated.

LECT. X. ASTRONOMY.

OF the Earth. Its Figure proved by Menſuration. Apparent Motion of the Stars, &c. round the Earth accounted for. Its Circumference, Diameter, and Periodical Revolution round the Sun. The Difference of Seaſons, and Inequality of Day and Night, explained experimentally by an elegant Tellurian. The Difference between the Summer and Winter's Heat, Cauſe of. Why the Earth is ſometimes nearer, at other Times farther from the Sun, and how it happens that our greateſt Heat is when the Earth is at the greateſt Diſtance from the Sun. The Summer Half Year longer than the Winter Half Year, and why. Preceſſion of the Equinoxes, what. Reaſons for altering the Style. Equation of Time, what. The Atmoſphere, what, and its Uſe. Cauſe of Twilight. Of the Loadſtone or Magnet. Its Properties. By whom diſcovered. When firſt applied to Navigation. How its Virtues may be communicated to Steel, &c. How deſtroyed. The Method of making Artificial Magnets, and how their Virtues may be preſerved, ſhewn. The Courſe of the Magnetic Effluvia, illuſtrated. The Variation and Dip of the Needle, what.

LECT. XI. ASTRONOMY.

THEORY of the Moon. Librations in Longitude and Latitude, what. Has no Variety of Seaſons, and why. Has no Atmoſphere. Cauſe of thoſe cloudy Appearances upon her Diſk. Her Phaſes ſhewn. The Inclination the Ecliptic has to the Horizon, how found. How the Moon's Path comes to be always concave to the Sun, explained. Apogee and Perigee, Points of; have a ſlow direct Motion round the Sun, experimentally ſhewn by an elegant Lunarian. Horizontal Moon, Appearance of. Harveſt Moon explained. Great Length of Moonlight at the Poles, Cauſe of. The Nature and Limits of Solar and Lunar Eclipſes, explained by an elegant Machine, called an Eclipſareon. Moon's Nodes, what; have a ſlow retrograde Motion round the Sun, ſhewn by Experiment. The Moon when totally eclipſed not inviſible, and why. Total Darkneſs at the Time of our Saviour's Crucifixion, not owing to a Solar Eclipſe, but ſupernatural.

LECT. XII. ASTRONOMY.

OF the Solar Syſtem. The Ptolomean, Tychonic, and Pythagorean Syſtems, explained by an elegant Planetarium. Of the Sun; his Situation, Magnitude, and Revolution round its Axis. The Order,

der, Magnitudes, and Diſtances of the Planets from the Sun. Periodical Times of Revolution, and Satellites. Their different Appearances as ſeen from the Earth, and from the Sun. Heliocentric and Geocentric Latitudes, Meaning of. Conjunctions and Oppoſitions, what. Direct and retrograde Motions, and Times of being ſtationary, experimentally illuſtrated. The Curves apparently deſcribed by the Planets in their Revolutions round the Earth. The Spots upon the Sun's Face, what ſuppoſed to be. Parallax, what, with its Uſe. Longitude, how found. Incomprehenſible Velocity of Light, proved. Theory of the Comets. Of the fixed Stars. Concluſion.

EXPLANATION *of* UNCOMMON WORDS *unavoidably made Uſe of in the Courſe of theſe Lectures.*

A

Abberration, a deviating from
Abſorb, to drink in
Acidulous, ſour
Accelerated, haſtened forward
Accumulate, to heap up
Adhere and Adheſion, a ſticking together
Affinity, having an Affection for
Alkali, Subſtances fermenting with Acids
Analogy, Likeneſs to
Annihilate, to reduce to nothing
Attenuate, to make thin, to rarefy
Attraction, to draw towards each other
Attrition, Bodies rubbing againſt one another
Axis, an Axle on which a Body turns.

C

Calcination, a reducing of Metals into Powder by Fire
Calx, the Cinders of a Metal
Capillary, as fine as a Hair
Cauſtic, a burning, corroding
Centrifugal, an Inclination to fly from the Centre
Centripetal, tending towards the Centre
Chryſtalization, Salts ſhooting into their natural Forms
Coheſion, a ſticking together
Collateral, lying Side by Side
Colliſion, a pounding or breaking
Compreſs, to ſqueeze together
Concave, ſpherically hollow
Condenſe, to bring the Parts of Matter cloſer together
Contact, touching each other
Converge, to draw towards a Point
Convex, ſwelling ſpherically outwards
Curve, a crooked Line
Cylinder, ſhaped like a Garden Roller

D

Denſity, Compactneſs, Cloſeneſs
Diagonal, a Line drawn to oppoſite Corners of a Square or Parallelogram
Diverge, to ſpread out

E

Ebullition, a bubbling like boiling Water
Effervesſcence, a fermenting
Elaſtic, having a Spring
Electrometer, an electrical Gage
Ellipſes, Ovals, Egg ſhaped
Equilibrium, a Balance

F

Fibre, a ſmall String
Flaccid, looſe, flabby
Frigorifick, chill, producing Cold
Fulcrum, a Prop, or Point of Support

G

Gravity, Weight, a Tendency one Body has towards another

H

Hemiſphere, half a Globe
Hermetically ſealed, a Tube cloſed at one End with Glaſs
Heterogeneal, of different Kinds
Homogeneal, of the ſame Nature
Hypotheſis, a Suppoſition

I
Immerge, to dip or plunge in
Impel, to drive onwards
Impinge, to ſtrike againſt
Incidence, a falling or lighting on
Incompreſſible, not to be ſqueezed into leſs Compaſs
Indefinite, unlimited
Inſulate, to cut off, like an Iſland
Intenſity, Weight, or Gravity
Interſtices, Intervals, or intermediate Spaces
Inverſely, or contrary to
Inverted, turned upſide down

L
Lateral, ſideways
Longitudinal, lengthwiſe

M
Medium, a Means of Conveyance
Momentum, the Force wherewith a Body moves

O
Oblique, crooked, inclining
Orbit, the Path deſcribed by a Planet in its Courſe round the Sun

P
Paradox, ſomething ſurpriſing, yet true
Particles, minute Parts
Percuſſion, a ſtriking, or the Effects of a Stroke
Perforate, to bore through
Periodical, the Time in which a Planet finiſhes its Courſe in its Orbit
Periphery, the Circumference of a Circle
Phenomenon, an Appearance in Nature
Phlogiſton, the inflammable Principle in Bodies
Piſton, a moveable Plug, juſt fitting a Pipe
Preponderate, to deſcend, outweigh
Progreſſive, advances, or goes forward
Projectile, a Body thrown off with a Force

R
Radius, a Line drawn from the Centre to the Circumference of a Circle
Rarefy, to make thin
Ratio, Proportion
Reciprocal, mutual, relative
Reflection, a turning back
Refract, to break, or incline
Renovation, a Renewal
Reſervoir, a Ciſtern, or Pond for the collecting of Water
Reverberate, to throw back, to echo
Rotation, a turning round

S
Saturation, abſorbing, incapable of containing more
Secrete, to ſeparate
Senſorium, the Seat of Perception in the Brain
Solution, a diſſolving
Species, a Sort or Kind
Specific, Bulk for Bulk
Spiral, coiled round like a Rope
Subſtitute, in Room of
Subterraneous, within the Earth
Superinduce, to add to
Syphon, a bent Tube
Syſtem, compoſing a general Structure

T
Tangent, a ſtraight Line touching the Circumference of a Circle
Tranſit, the Paſſing of a Planet acroſs the Sun, or over the Meridian

U
Undulating, a rolling like Waves

V
Vacuum, a Space free from Air
Valve, a Trap-Door, permitting a Fluid to paſs through, but not return
Velocity, the Speed with which a Body moves
Vertex, the Point at the Top of any Thing
Vibrate, to ſwing backwards and forwards
Vitrify, to turn to Glaſs
Volatile, to fly off, or evaporate

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